GUIDELINE 7 - LAND TREATMENT OF PETROLEUM CONTAMINATED SOIL: SINGLE APPLICATION SITES

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I. Introduction

The North Dakota Department of Health (Department) requires that excavated petroleum contaminated soil be treated or disposed of properly. Incorporation of petroleum contaminated soil into the top six inches of native soil can be an effective treatment option. Land treatment of wastes can be effective when approached scientifically; it takes advantage of naturally occurring soil microorganisms to biodegrade petroleum. Some volatilization of petroleum hydrocarbons will also occur during the process.

The Department has generally recommended that petroleum contaminated soil be treated through land application at existing municipal waste or special waste landfills. On a case-by-case basis, the Department will consider allowing treatment at other sites when land treatment at a landfill is not feasible. This document provides information on suitable site and soil characteristics, land application procedures, soil sampling procedures, and the Department's approval requirements for sites receiving a single application of petroleum contaminated soil. On a case-by-case basis, depending on the site capabilities and the waste material, the Department may allow two or three site applications on discrete areas of a single application site; however, appropriate documentation must be provided as outlined herein. Except as provided under this variance, owners or operators of a site in which repeated applications of petroleum contaminated soil are proposed must meet the requirements of Article 33-20 of the North Dakota Administrative Code.

Form SFN-51601 entitled "Land Treatment Variance Application" must be completed and submitted to the Department for approval prior to land application at single application sites.

II. Background Information

The following list outlines the minimum information which should be provided to the Department with the application:

A. Land treatment site location description and site location map.

B. Landowner's name, address, telephone number, and approval.

C. Documentation of approval or notification (providing a reasonable time for response) of the appropriate local officials (county, city, or township).

D. Topographic and soil survey maps with the proposed land treatment site outlined and a map scale presented.

E. Estimated volume of soil to be land treated.

F. Projected date of soil application.

G. Site and soil characteristics (see below).

H. Proposed land application procedures (see below).

I. Proposed sampling, tillage, and reporting schedule (see below).

J. Any previous history of waste disposal activities at the proposed site.

III. Site and Soil Characteristics

Published soil survey information (available through local Natural Resources Conservation Service offices) provides an excellent reference for site slope, depth to ground water, and soil type for most locations in North Dakota. If specific soil information is not available or if more detailed soil information is required, a Professional Soil Classifier can be utilized to determine site-specific soil conditions. Soil borings or trenching, or a hydrogeologic evaluation, may be required to evaluate the proposed land application site.

The recommended site and soil characteristics for a land treatment site are as follows. The Department may make exceptions to the recommended criteria on a site-specific basis.

A. Site slope: 6 percent maximum.

B. Minimum distance to surface water: 200 feet.

C. Minimum distance to residences or buildings: site-specific, but in general, 200 feet.

D. Minimum depth of three feet to seasonal high water table for most soils.

E. Soil characteristics:

1. Permeability: slow to moderate, less than two inches per hour. Areas underlain by highly permeable soils, very slowly permeable soils, or sodium affected soils should be avoided.

2. pH: minimum pH of 6.5, neutral or slightly alkaline preferred.

3. Nutrients: soils with moderate to high levels of fertility are preferred.

Unsuitable land application sites include closed areas of landfills and environmentally sensitive areas such as flood plains. Areas with highly permeable soils or areas that are excessively steep should not be considered for land treatment sites.

Adequate soil nitrogen and phosphorus levels are critical for bacterial growth and effective land treatment of contaminated soil. Soil nitrogen and phosphorus tests are recommended to determine if minimum fertility levels exist at the land treatment site, and if fertilizer application is necessary. See Part IV.B for details on soil fertility sampling and testing. The amount of soil nitrogen necessary for effective land treatment is based on a ratio of parts per million (ppm) Total Hydrocarbons © to ppm Nitrogen (N). The Department considers a C:N ratio of 100:2 acceptable. Adequate extractable soil phosphorus levels are also required for effective land treatment.

Recommended land treatment site fertility levels are listed in the following table. The table illustrates what fertility levels are required to maintain a C:N ratio of 100:2 at specific total hydrocarbon concentrations. Using results from soil fertility testing, one can determine if fertilizer should be added to the treatment site. For example, assume soil contaminated with 2000 ppm total hydrocarbons is land treated. If soil fertility tests indicate the six-inch surface layer contains 40 pounds per acre nitrogen, an additional 40 pounds per acre nitrogen should be added to the treatment site. Extractable soil phosphorus levels should be maintained in the 20 to 30-pound per acre range.

Soil Contaminant Concentration	Fertility Requirements (Lbs./Acre) Nitrate-Nitrogen	Extractable Phosphorus
1000 ppm Total Hydrocarbons	40	20-30
1500 ppm Total Hydrocarbons	60	20-30
2000 ppm Total Hydrocarbons	80	20-30
2500 ppm Total Hydrocarbons	100	20-30
3000 ppm Total Hydrocarbons (or greater)	120	20-30

NOTE: Fertility levels assume four-inch soil application thickness. Maintain proportionally lower fertility levels for thinner soil application. Fertility levels should not exceed 120 pounds per acre nitrate-nitrogen or 30 pounds per acre extractable phosphorus.

IV. Land Application Procedures

Recommended procedures for land application are described below. The Department will consider exceptions on a site-specific basis.

A. Contaminated soil should be applied only when the land is tillable, but no earlier than April 1 and no later than November 1. If contaminated soil is to be stockpiled, it should be in an area where surface water run-on and runoff are controlled.

B. Surface water run-on and runoff should be diverted or contained around storage and treatment areas. Ditches and berms up slope of the site should divert surface water run-on around and away from the treatment area. Surface water runoff should not cause degradation of any streams, rivers, wetlands, lakes, etc. Berms, ditches, or impoundments down slope of the site may be needed to contain and store any contaminated runoff during precipitation events.

C. Contaminated soil should not be applied more than four inches thick. Thinner applications may be required on a site-specific basis. Soil application rates for specific application thicknesses are as follows:

1. 530 cubic yards/acre at 4-inch spreading thickness
2. 400 cubic yards/acre at 3-inch spreading thickness
3. 270 cubic yards/acre at 2-inch spreading thickness
4. 135 cubic yards/acre at 1-inch spreading thickness

(1 cubic yard = 27 cubic feet, 1 acre = 43,560 sq. ft.)

The petroleum loading rate should not exceed approximately 2 percent or 20,000 parts per million (ppm) total petroleum hydrocarbons as fuel oil or gasoline in the soil to be land applied. This corresponds to approximately 67 barrels (2800 gallons) per acre for soil applied four inches thick and contaminated with a relatively heavy oil.

D. Contaminated soil application method (dozer, grader, spreader, etc.) should be specified.

E. Land applied soil should be incorporated (mixed) with the upper four to six inches of native soil within 48 hours after application. Fertilizers should be broadcast either just before or just after contaminated soil application, but prior to contaminated soil incorporation. Fertilizer should be added as necessary to maintain an optimum C:N ratio of 100:2 and extractable phosphorus levels of 20-30 pounds per acre.

F. To enhance hydrocarbon breakdown, the soil should be tilled at least four times during the land application season. Less frequent tillage may not provide adequate aeration and mixing and, therefore, may slow hydrocarbon breakdown. More frequent tillage could be done if soil moisture is adequate, soil compaction is not a problem, and wind erosion can be controlled.

For fields where petroleum contaminated soil is land applied prior to July 1, tillage may not be needed in subsequent years. However, soil monitoring should continue until contamination is below levels, as outlined in Part IV.C. For land applications after July 1, a minimum of four tillage operations are necessary (excluding the period from November 1 to April 1), unless soil monitoring results are below the acceptable levels (Part IV.C).

G. Depending on site conditions, climatic conditions, and other factors, measures to control soil moisture and wind erosion as well as to improve the soil bacterial culture may be necessary. If the soils are excessively dry, addition of moisture to the site may be necessary (ponded surface runoff water could be used). Optimum soil moisture content is 50-70 percent of the soil water holding capacity. More frequent tillage or site drainage may be necessary if the site is wet. The incorporation of grass or legume hay is advised to help control wind erosion and improve soil aeration. If the soil is deficient in organic matter and/or oil-degrading soil bacteria, the addition of inoculants, rotted manure, mature compost, or topsoil is advised.

V. Soil Sampling Requirements

A. Contaminated stockpiled soil: Soil samples are necessary to evaluate and document contamination levels in the soil to be treated. Obtain a composite soil sample by digging a minimum of one foot into the pile at least three places within the pile before collecting subsamples. To avoid cross-contamination, subsamples should be taken using clean disposable gloves (and other clean sampling utensils) at each sample location (refer to NDDH “Procedures for the Collection of Soil Samples at Underground Storage Tank (UST) Sites”). Mix equal portions of each subsample to obtain a composite sample. Completely fill each sample vial so that no headspace exists, wipe soil from the vial threads, and seal the vial using a cap

with a Teflon septum. Label the vial, wrap it in aluminum foil, and place in a covered cooler with ice for transport to a laboratory for analysis.

The number of soil samples should be based on the following table:

Volume of Soil (cubic yards)	Number of Samples
<10	0
10-50	1
50-500	2
500-1000	3
1000-2000	4
2000-4000	5
Each additional 2000	One additional sample

Soil samples should be analyzed for total petroleum hydrocarbons as fuel oil or gasoline, lead (for leaded gasoline or any lead-bearing petroleum hydrocarbon, required once per sample prior to application) and pH. Other analysis such as benzene, ethylbenzene, toluene, and xylenes may be necessary depending on site conditions or depending upon the product involved.

B. Land application site soil fertility level determination: A composite of several representative soil samples from the top six inches of native soil should be collected to evaluate fertility status of the proposed land application site. The composite sample should be handled and prepared for analysis in accordance with the procedures recommended by the soil testing laboratory to be used.

Soil fertility samples should be analyzed for nitrate-nitrogen, extractable phosphorus, and pH according to methods accepted by the North Dakota State University Soil Testing Laboratory (telephone 701-231-8942). Nitrate-nitrogen levels are generally reported in pounds per acre, whereas extractable phosphorus levels are generally reported in ppm. To convert pounds per acre to ppm, divide by two. Conversely, to convert ppm to pounds per acre, multiply by two. For example, 80 pounds per acre nitrate-nitrogen equals 40 ppm, and 10 ppm extractable phosphorus equals 20 pounds per acre.

C. Follow-up monitoring: Follow-up monitoring is recommended to assess and document hydrocarbon breakdown. Soil samples should be taken from a depth of four to six inches in the land treatment area (using the sampling methods discussed in Part IV.A above). The number of samples to be taken at each sampling interval should follow the table in Part IV.A and should adequately represent the entire land treatment area. Samples need only be analyzed for total petroleum hydrocarbons; however, the Department may require sampling for additional constituents under some circumstances.

During the year of land application, samples should be taken at the times specified below until soil analytical results indicate 10 ppm total petroleum hydrocarbons or less.

Land Application Date	Soil Sampling in First Year
Before July 1	Once in August & once in October
July 1 to September 15	Once in October
After September 15	None

Sampling in subsequent treatment years should include three samples taken approximately in June, August, and October, unless results indicate 10 ppm total petroleum hydrocarbons or less.

Refer to Form SFN-50336 “Soil Monitoring Results for Land Treated Petroleum Contaminated Soil” for reporting results.

VI. Submittal and Approval Process

The form SFN-51601 “Land Treatment Variance Application” should be completed and submitted with the maps and information to the Department. Arrangements should be made with the Department for a site inspection. The site inspection will be done by either Department staff, by an individual authorized by the Department (e.g., local government officials), or by a qualified environmental consultant whose evaluation is subject to Department review and approval. If approved, the inspector will sign and date the application form. On a site-specific basis, a site inspection may not be required.